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Maturity and Handling of Green-Wrap Tomatoes in Mississippi

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IMPORTANCE OF MATURITY AND CORRECT HANDLING

Tomatoes, one of the most important and widely grown protective foods, must be correctly handled to reach the consumer in prime condition and to conserve shipping space. For the necessary long-distance shipments from the South and the Pacific coast most green-wrap tomatoes are picked in the mature-green stage, but sometimes immature tomatoes are included.

In the 5-year study of Gulf State Market tomatoes in Mississippi it was found that maturity could be judged more accurately by considering a combination of the various visual external characteristics than by any single characteristic. In these experiments tomatoes reached the mature-green stage about 27 days after they had set.

Tomatoes harvested when immature ripened only 1 day earlier than comparable tomatoes allowed to remain on the vines until they had reached the mature-green stage. When ripe they were of inferior quality and appearance, in contrast to the satisfactory quality of those harvested later.

Although cracking increased with advancing maturity, it was not serious until the fruits had passed the mature-green stage. A significantly higher percentage of the immature tomatoes decayed than of those harvested later.

[1] The author gratefully acknowledges his indebtedness to D. F. Fisher, under whose general direction this work was conducted, and to G. B. Ramsey and R. C. Wright, also of this Division, for numerous suggestions in carrying it out.

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Ascorbic acid (vitamin C) content increased with maturity, but no relation was found between maturity and soluble solids or sugars.

Specific gravity, total acidity, and hydrogen-ion concentration increased and resistance to puncture decreased with maturity, but the variations of the first three were so great and the differences in resistance to puncture so small that these characteristics could not be used for differentiating immature and mature fruits.

Tomatoes increased in size with maturity, but the rate of increase decreased as the fruit approached the turning stage. During ripening, the most immature fruits lost 4.6 percent of their weight and the most mature ones only 2 percent.

Much of the decay that developed in commercial packages was associated with skin breaks. Wiping tomatoes with grains of sand adhering caused minute scratches that became dark and unsightly. Rough handling, especially during rainy periods and when the fruits were immature, sometimes resulted in an adverse effect on shipping quality or appearance. Shoulder bruises caused by the abrasive action of the rough sides and bottoms of the field crates on the fruits can be reduced by using the planed sides of the shook on the inside.

No evidence of blossom-end rot development after harvest was found.

PRACTICAL RECOMMENDATIONS

In the light of these investigations it is suggested that tomatoes be allowed to remain on the vines until they have reached the mature-green stage and preferably until just before they have started to turn, as it is shown that harvesting in the immature stage not only fails to put ripe fruits on the market earlier but results in a product which is inferior in quality and appearance. In addition, increased tonnage can be obtained by allowing the fruits to remain on the vine as long as possible. There was approximately a 12-percent increase in size during the 4-day period just before the tomatoes started to turn.

Since most of the decay which developed in commercial packages was associated with skin breaks, it is suggested that every effort in harvesting and preparing tomatoes for market be made to prevent breaking the skins. Shoulder bruising can be reduced by using the planed side of the shook on the inside when making field crates.

DEFINITION OF MATURITY AND RIPENESS

Maturity changes all occur while the fruits are attached to the plant. A mature tomato is one that has reached a stage at which it may be harvested, even though green, and then ripened to satisfactory quality.

A ripe tomato is one that is fully colored and ready to be consumed. Changes in ripeness of mature-green tomatoes take place after they are harvested, but if such tomatoes are not harvested they will of course ripen on the vine. In classifying tomatoes as to stage of ripeness the terminology of Sando (*17*) [2] has been followed. A tomato is green when red is absent, turning when there is a trace of red at the stylar end, pink when most of the fruit is red although not fully ripe, and ripe when it is fully colored and ready to be eaten.

MATERIALS AND GENERAL METHODS

Most work reported in this circular was conducted on tomatoes grown in the vicinity of Crystal Springs, Miss., from 1937 to 1941, inclusive; a limited amount

[2] Italic numbers in parentheses refer to Literature Cited, p. 11.

of work also was done with fruit grown at Meridian, Miss., during the first two seasons. All the tomatoes were obtained from plants pruned and staked according to commercial practice in the Crystal Springs district. The variety used in the maturity investigations was the Gulf State Market, the principal one grown in the district.

Two methods were employed to obtain tomatoes of known ages for the maturity work. One method was to tag about 1,500 tomatoes each year immediately after they had set (ovaries starting to swell) and to harvest at intervals. The other method consisted of tagging at intervals a number (about 200 at each date) of tomatoes immediately after they had set, using a different shape or color of tag each time, and harvesting all the fruit at the same time. It was possible in this manner to harvest at one time tomatoes of different ages and also to harvest at different times those which had set at the same time. Since a high percentage of the blossoms fail to set, it was decided to tag the fruits immediately after they had set rather than to tag the freshly opened blossoms. The ages of the fruit given are therefore computed from the time the fruit set.

Soluble solids, sugars, acid, and pH were determined on juice expressed from the tomatoes immediately after they were harvested. In nearly all cases 25 tomatoes constituted a sample. In a few instances where the quantity of fruit was limited as a result of loss by decay, 15 or 20 tomatoes constituted a sample. Percentage of soluble solids was determined with an Abbe refractometer; pH was determined with a glass electrode. In 1937 total acidity was determined by titration with 0.1 N NaOH and with phenolphthalein as an indicator and in the later work by electrometric titration to a pH of 8.0 with 0.1 N NaOH.

The sugar contents before and after inversion were determined by the Quisumbing-Thomas method, the cuprous oxide being determined by the volumetric permanganate method.

Ascorbic acid was determined on the juice of the tomatoes after they had ripened. The method of determination was an adaptation of Mack and Tressler's (*10*) modification of the Bessey and King (*1*) method. An equal volume of acid mixture (0.25 N metaphosphoric and 1 N sulfuric) was added to the juice and thoroughly mixed. After being centrifuged, an aliquot of the clear liquid was titrated against a 0.1-percent solution of sodium 2,6-dichlorobenzenoneindophenol which had been standardized with a freshly prepared ascorbic acid solution.

At the time of harvest the approximate specific gravity of the tomatoes was determined by placing representative samples in successive alcohol-water mixtures of known specific gravities and noting the densest mixture in which the fruits sank.

The puncture data were obtained at the time of harvest by determining the pressure in grams required to puncture the fruit with the end of a wire 0.035 inch in diameter. Four tests were made on each tomato.

The sound tomatoes which were not used for analysis were wrapped and placed in the ripening room. Decay in ripening, time required for ripening, and appearance and flavor after ripening were determined. In 1939 and 1940 ascorbic acid was also determined after ripening. The temperature and the relative humidity of the ripening room in each of the 5 years are given in table 1.

TABLE 1.—*Temperature and humidity of ripening room*

Year	Temperature	Relative humidity	Year	Temperature	Relative humidity
	°F.	*Percent*		°F.	*Percent*
1937	76	75	1940	73	84
1938	71	83	1941	72	86
1939	70	82			

RELATION OF AGE TO MATURITY

Maturity ratings were made in most instances by shipping-point inspectors; other ratings were made by the author, using the same standards. Cutting a representative sample of tomatoes was found to be a desirable method of determining the general maturity of a lot, but this results in the loss of the tomatoes which are cut. According to United States standards (*18*) for fresh tomatoes,

> . . . a tomato is considered mature when the seed cavities have developed a jellylike or gluelike consistency and the seeds are well developed. In a practical test a sharp knife should be used and the tomato cut crosswise of the seed cells. If the pulp that surrounds

the seeds has become jellylike and the seeds give way before the edge of the knife and are not cut in slicing, the tomato is considered mature enough to be shipped.

If the cut tomato shows a tinge of red or orange color on the inside, there is no question about its maturity. Other characteristics used to determine the maturity of tomatoes are the development of the brownish ring under the calyx, the yielding to pressure, the appearance of yellowish or cream-colored streaks at the stylar end, the absence of "feathering," and the development of a brownish tinge on the shoulder of the fruit.

The estimation of maturity from all the various external characteristics, together with general appearance of the tomato, was found to be more reliable than any single characteristic in itself. Although it is not possible to determine accurately the maturity of a green tomato from external characteristics, an experienced person is able to sort out most of the immature tomatoes from a lot, especially if he cuts a sample occasionally to correlate internal development with external characteristics of the particular lot.

As shown in table 2, tomatoes were generally considered to have reached the mature-green stage about 27 days after tagging (after the fruit had set). The period varied slightly in the different seasons. Generally, turning did not begin until at least 30 days after tagging, and the period averaged 31.7 days.

Turning of tomatoes does not usually begin until about 4 days after they reach the mature-green stage. If delay of that length of time in picking were the regular procedure, shippers could get more mature tomatoes on the market without appreciable loss because of the delay. Also this procedure would be especially valuable in a season such as that which prevailed in Mississippi in 1939. Because of a bad rainy period just before and during the early part of that shipping season, serious losses resulting from poor carrying quality were incurred. Losses from fruit rotting in the field, although serious enough, are less serious than those from equal amounts of fruit rotting in transit. In the latter case the costs of packing and shipping decayed fruits, as well as of the fruit itself, are lost. Furthermore, the presence of rotten fruit in a consignment reduces the sales value of the entire lot.

RELATION OF MATURITY AND VARIOUS OTHER CHARACTERISTICS

Rate of Ripening

Frequently tomatoes are shipped in an immature stage in an attempt to get ripe fruit on the market earlier. In the column of table 2 headed "Period from fruit setting to ripening" it can be noted that tomatoes harvested at the most immature stage ripened only 4 days earlier than identical fruits allowed to remain on the vine 16 days longer until they reached the "turning to ripe stage." Tomatoes harvested at the immature stage had become ripe and ready to be consumed only 1 day earlier than similar tomatoes allowed to remain on the vine 9 days longer until they reached the mature-green stage. From this it appears that shippers succeed in getting ripe tomatoes on the market only 1 day earlier by harvesting them in an immature rather than in the mature-green stage.

However, temperature as well as maturity influences the rate of ripening of tomatoes. The effects of various temperatures on the storage and ripening of tomatoes after harvest have been extensively investigated by Wright, Pentzer, Whiteman, and Rose (*21*). They found that the lowest temperature at which satisfactory ripening will take place is 55° F. and that the rate of ripening increases at 60° to 70°. They do not recommend temperatures much higher than 70° because of danger of decay. Temperatures of 80° or above may result in uneven or blotchy color (*20*).

Cracking and Decay

As shown in table 2, cracking increased sharply with advancing maturity, but it was not serious until the maturity passed the mature-green stage. These results are in agreement with those of Frazier (*3*), who reported that the tendency to cracking increases with advancing maturity of tomato fruits and that after the fruits reach the mature-green stage, the possibility that the cracking will be severe is greater. Decay during ripening was least in tomatoes harvested at the mature-green stage. However, the differences were not significant, except that

TABLE 2.—*Characteristics of tomatoes at various stages of maturity*

EXPERIMENTAL DATA

[Each value is the mean of 4 to 10 tests]

Maturity	Period from fruit setting to picking	Period from fruit setting to ripening	Fruits cracked	Fruits decayed during ripening	Specific gravity	Ascorbic acid content of juice	Soluble solids	Total sugar	Total acidity (as citric acid)	Hydrogen-ion concentration	pH
	Days	*Days*	*Percent*	*Percent*		*Mg. per ml.*	*Percent*	*Percent*	*Percent*	($\times 10^{-5}$)	
Immature	18.7	35.3	0	9.70	0.931	0.120	6.21	3.01	0.325	5.40	4.27
Immature to mature-green	23.2	35.5	1.00	2.80	.939	.131	5.76	2.99	.390	6.59	4.18
Mature-green	27.4	36.4	6.44	1.30	.944	.154	5.19	3.07	.462	8.99	4.05
Mature-green to turning	31.7	38.4	20.80	2.50	.950	.168	6.00	3.11	.552	12.04	3.92
Turning to ripe	35.0	39.3	46.33	4.50	.958	.178	5.77	3.15	.577	12.22	3.91
Difference between maturities required for—											
Significance	2.4	.9	13.9	4.83	.005	.023			.068	2.31	
High significance	3.3	1.3	18.8		.007	.031			.095	3.23	

ANALYSIS OF VARIANCE

Source of variation	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square
Total	49		49		44		49		19		19		39		19		39		39	
Between maturities	4	423.45**	4	31.87**	4	3,395.966**	4	108.98*	4	0.000416**	4	0.002382**	4	1.1731	4	0.0259	4	0.090965**	4	76.7921**
Between tests	9	6.49	9	13.09	8	635.858	9	46.44	3	.000172	3	.002918	7	2.4708	3	.0528	7	.051364	7	83.3308
Remainder (error)	36	7.16	36	1.10	32	210.466	36	28.36	12	.000012	12	.000228	28	.4527	12	.0573	28	.003846	28	4.48127

*=Significant (exceeds 5-percent point); **=highly significant (exceeds 1-percent point).

decay in tomatoes harvested at the immature stage was significantly higher than that in those harvested at more mature stages. These immature tomatoes were so slow in ripening that they frequently decayed before they could ripen. In commercial practice, where tomatoes are handled in a packing house, the decay of tomatoes which had reached the turning stage would doubtless be higher, because they will not withstand the rough handling incident to present packing-house procedures.

Quality and Color After Ripening

Table 3 gives the color and flavor after ripening of tomatoes harvested at various maturities. Flavor and internal color improved with advancing maturity. External color also became deeper with advancing maturity, but some of the more mature fruit failed to color well at the base. In general, satisfactory quality was obtained with tomatoes harvested at the mature-green stage or later, whereas tomatoes harvested when immature were always of inferior quality.

These results agree with those of Friend (*4*) who found that certain varieties develop a very poor, unattractive color when the fruits are harvested in an immature stage. In a study of the ripening and repacking of mature-green tomatoes in terminal markets Wright and Gorman (*20*) reported that the poor quality frequently found in tomatoes on the market during the winter months is chiefly due to their having been too immature when picked.

Table 3.—*Relation of maturity of tomatoes and their quality after ripening*

Maturity	External color	Internal color	Flavor
Immature	Generally dull and pale; poor to fair.	Generally yellowish; poor to fair.	Generally poor; sometimes sour.
Immature to mature-green.	Fair to good; generally pale	Fair to good; slightly yellowish.	Fair to good.
Mature-green	Good	Good	Good.
Mature-green to turning	Generally good; some very good.	do	Generally good; some very good.
Turning to ripe	Good to very good; generally some greenish or yellowish at base.	Good to very good	Generally very good.

Specific Gravity

As shown in table 2, the average specific gravity of the solution in which the tomatoes sank increased with their increasing maturity. Although the more mature tomatoes had on an average the higher specific gravity, the method cannot be used to determine definitely whether one tomato is more mature than another, as there was considerable variation within stages of maturity. Some tomatoes of higher specific gravity were less mature as judged by their rate of ripening than others of lower specific gravity. Fruits or other objects having cavities only partially filled with seeds or tissue and containing various amounts of air or other gas mixtures generally give rather erratic results for specific-gravity measurements.

Ascorbic Acid (Vitamin C) Content

The ascorbic acid (vitamin C) content of tomatoes of various maturities is given in table 2. There was in general a gradual increase in ascorbic acid content with advancing maturity. The ascorbic acid content of the tomatoes harvested at the mature-green stage was 1¼ times that of the immature tomatoes. The importance of allowing tomatoes to become mature so that ascorbic acid content is at its maximum seems obvious.

However, the findings of different investigators regarding the effects of maturity on ascorbic acid content do not all agree. Maclinn and Fellers (*11*) found no consistent increase in the ascorbic acid content of tomatoes during the three stages of maturity that they described as "hard green," "half ripe," and "full ripe." On the other hand, Tressler, Mack, and King (*19*) reported that fully ripe tomatoes contain nearly twice as much ascorbic acid as green tomatoes. Hoffman and associates (*7*, *8*) and Murphy (*13*) also stated that vitamin C increases as the fruit reaches maturity. Reynard and Kanapaux (*16*) found that green tomatoes

have slightly but not significantly less ascorbic acid than ripe ones. Morgan and Smith (*12*) reported less vitamin A in green tomatoes than in ripe ones. Hamner and Maynard (*6*) reviewed the literature pertaining to the nutritive value of the tomato, including its vitamin C content.

Content of Soluble Solids, Sugars, and Acids

Sando (*17*) made an extensive investigation of certain physiological changes occurring in tomatoes during development, beginning with those 14 days after blossoming and continuing until the fruit was red. In general, he found an increase in moisture, acids, and sugars and a decrease in solids, total nitrogen, starch, pentosans, crude fiber, and ash during development. Sando also presented an extensive review of the literature pertaining to the composition of tomatoes, especially with respect to changes taking place during maturation. As shown in table 2, in these studies there was no consistent or clear-cut relation between soluble-solids or sugar content and maturity. Most of the sugars found were reducing sugars.

Bohart (*2*) found an appreciably higher pH value in two varieties of tomatoes harvested when ripe than when harvested green. Hoffman and associates (*7*, *8*) reported that acidity increases rapidly as tomato fruits reach full size but decreases somewhat during ripening. In the present studies total acidity and hydrogen-ion concentration increased with advancing maturity. However, these characteristics would not be suitable for differentiating mature and immature tomatoes, principally because the values vary considerably from year to year.

Relation of Pressure and Puncture Tests to Maturity

Resistance to puncture decreased slightly after the mature-green stage was reached. It was not suitable, however, for separating immature from mature tomatoes, because the differences were too small. Pressure-test determinations made with a "squeeze" tester, such as designed by Gorman and described by Haller, Harding, and Rose (*5*), showed no consistent relation between maturity and the pressure test of tomatoes. However, there is some relation between maturity and the time tomatoes start to soften as judged by "feel."

Size

A number of tomatoes tagged on May 21, 1938, were measured at intervals as indicated in table 4. Although about 100 tomatoes were tagged, the data are based on 31 tomatoes all of which started to turn when they were 34 days old. Those which showed signs of decay or insect damage were not included. It can be seen that the tomatoes increased in size throughout their maturation period but that the rate decreased when the fruit approached the turning stage. It is evident that from the standpoint of size there is considerable to be gained in leaving the fruit on the vines as long as possible. The proper time of picking should therefore be determined on the basis of increased size and quality with increasing maturity, together with the counterbalancing factors such as loss from decay or cracking. Similar results were obtained in 1937 with a somewhat smaller number of fruits.

Table 4.—*Size of tomatoes as influenced by maturity, 1938*

Age (days)	Size	Increase per day since previous measurement	Relation 28-day size	Age (days)	Size	Increase per day since previous measurement	Relation 28-day size
	Cc.	*Cc.*	*Percent*		*Cc.*	*Cc.*	*Percent*
14	62.5		37.7	28 [1]	165.6	6.05	100.0
19	98.7	7.24	59.6	30	178.1	6.25	107.5
23	129.6	7.97	78.3	32	187.5	4.70	113.2
26	153.5	7.97	92.7	34 [2]	193.4	2.95	116.8

[1] On an average, tomatoes were considered mature at 28 days but time varied from 26 to 30.
[2] Beginning to turn.

Loss in Weight During Ripening

A large number of individual tomatoes were weighed before and after ripening. The most mature ones (those that ripened first) lost 2 percent of their weight and the most immature ones 4.6 percent. This represents the actual weight lost as a result of transpiration and respiration, as the loss from decay was not included.

RELATION OF HANDLING TO SHIPPING QUALITY

Methods of Harvesting and Preparing for Shipment

Tomatoes in the Crystal Springs, Miss., district are harvested approximately twice a week, usually in baskets of ½- to 1-bushel capacity. They are then transferred to field boxes (carriers) of about 75-pound capacity and hauled to the edges of the fields where they are loaded on trucks and taken to the packing shed. In the past it was a common practice to pour the tomatoes from the grower's to the shed crates, but this procedure has been largely changed so that the general rule at present is for the grower merely to receive a number of empty crates equal to the number of full crates that he brought in.

Some packing sheds have mechanical grading tables and sizers, in which case the tomatoes are usually first poured into a washer from which they go over a grading table and thence to a sizer. Frequently the washing is omitted, especially if the tomatoes are not dirty. Although a large number of sheds have mechanical grading and sizing equipment, these operations are often done by hand. After being graded and sized, the tomatoes are individually wrapped and packed in 30-pound lugs and loaded into cars, usually five layers high. Some shippers load solid through the doorway, while others use bracing.

Decay in Relation to Skin Breaks

On each of six occasions during the several years that these experiments were conducted, four 30-pound lugs of commercially packed tomatoes of average size and U. S. No. 1 grade (except in one case where only two lugs of a grade with 85 percent No. 1 were used) were very carefully inspected and separated into four groups and the decay during ripening of each of these groups was recorded. The mean decay for each group was as follows:

Group:	*Percent decay*
Sound	3. 30
Bruised	5. 18
Scarred	6. 30
Skin broken	12. 13

The difference between groups required for significance is 6.24 percent.

It can be noted that the decay was nearly four times as great in the group of tomatoes which had skin breaks as in the sound group. The percentage of tomatoes with skin breaks in the various lots ranged from 9.4 to 30.3 percent. Some of the skin breaks were caused by improper handling during harvesting, such as by nails or unclinched wire stapling in picking containers; and others were caused by improper handling in the packing sheds, such as cutting by lids with excessively high bulges (fig. 1, *A*). The importance of avoiding breaks during harvesting and preparation for market is evident. As Ramsey and Link (*15*) pointed out in their extensive discussion of market diseases of tomatoes, although some rot-producing organisms can enter the unbroken skin of tomatoes, most of them enter only through skin breaks caused either by mechanical means or by growth cracks. Nightingale and Ramsey (*14*) reported the effects of temperature and pH on the development of tomato lesions and the pathogens.

Although bruised or scarred tomatoes showed a higher percentage of decay than comparable sound ones, the differences were not statistically significant. The market quality, however, was reduced, because bruised and scarred fruits are definitely inferior to the sound ones in appearance.

Sand Scarring

During or after rainy weather pickers, either consciously or unconsciously, wipe tomatoes with their hands or clothes. The sand adhering to the tomato

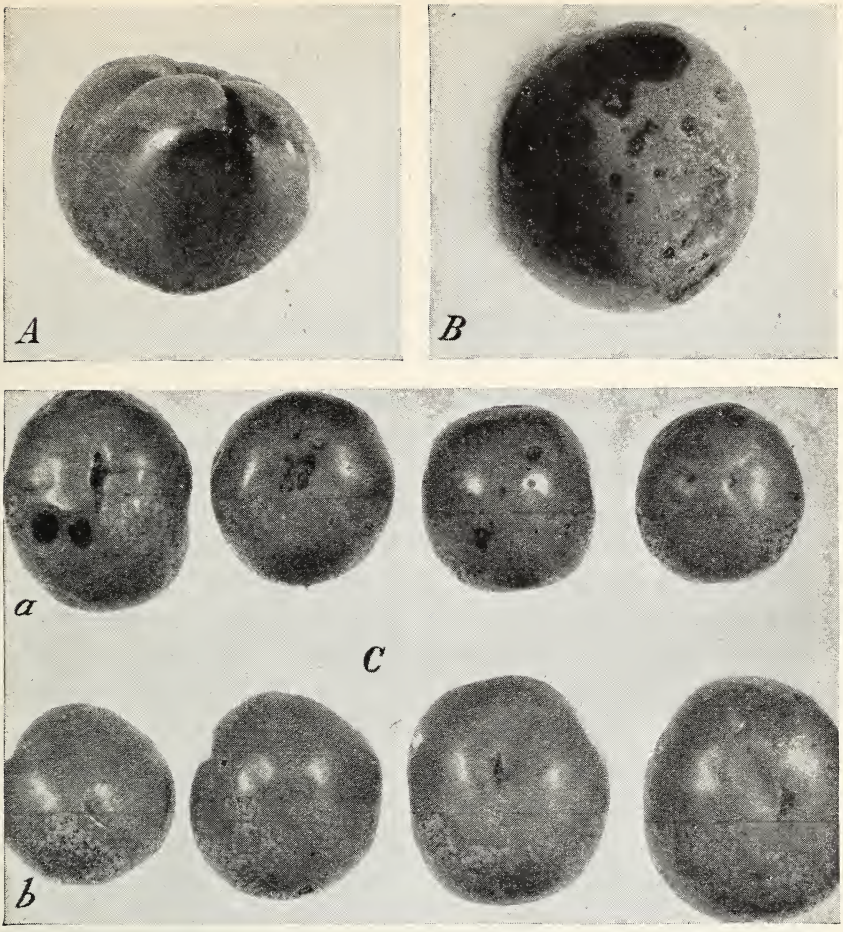


FIGURE 1.—*A*, Tomato with decay developing in a skin break caused in lidding; *B*, sand-scarred fruit; *C*, fruits picked on June 2, 1939, during a rainy period showing effects of ordinary handling (*a*) and of careful handling (*b*). Note some blemishes even on the latter.

causes minute scratches, which frequently turn dark in transit (fig. 1, *B*). Wiping dirty tomatoes with rags may produce similar effects. At times during or after rainy periods it is impossible to eliminate this trouble entirely, especially on fruit harvested from the first cluster, but careful handling results in less of this injury than ordinary handling.

BRUISING

As a rule, ordinary handling methods do not seem to affect mature-green tomatoes adversely, although sometimes when handled roughly they fail to color well under the bruised areas and sometimes they present a mottled appearance. Upon tomatoes harvested during rainy periods the effects of rough handling are more apparent (fig. 1, *C*). In general, severity of bruising was found to be more serious in immature than in mature-green tomatoes.

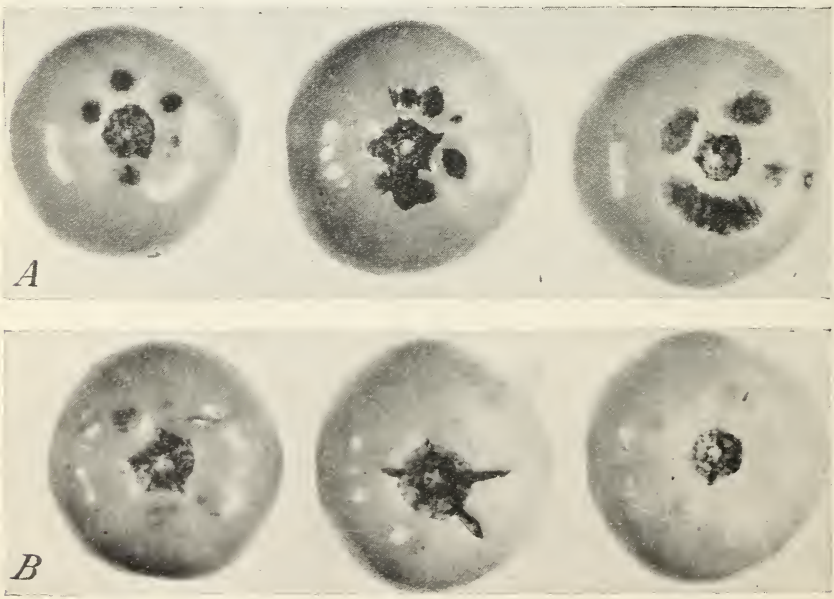
The detailed results obtained on shoulder bruising have been published elsewhere (5). A summary of the results follows:

> The shoulder of the tomato is much more susceptible to bruising than are the other parts of the fruit. Although shoulder bruising generally does not appear serious on mature-green tomatoes, it becomes conspicuous on these tomatoes when they ripen. Shoulder bruising appears to be caused by the abrasive action of the rough sides and bottoms of field carriers in contact with the shoulders. The tightness of the pack had little effect on the amount of shoulder bruising. Likewise, dropping tomatoes was a minor factor in causing shoulder bruises. Paper wraps such as are used in packing tomatoes in lugs were effective in reducing shoulder bruises in transit. The use of field boxes that had the smooth planed side of the shook on the inside was an effective practical means of reducing shoulder bruises, and lining the box with corrugated paper, paper toweling or excelsior pads caused an even greater reduction. (See fig. 2.)

BLOSSOM-END ROT ON THE MARKET

During the 1938 season there were several reports of blossom-end rot appearing on the market on tomatoes which were claimed to be free of this disorder at the shipping point. There were also reports of incipient blossom-end rot at the shipping point becoming serious on the market. Although several thousand tomatoes were handled by the writer during that season, there was no sign of blossom-end rot appearing after harvest; this would indicate that if the disease was present on the market, it was present also at the shipping point. On July 1, 1938, 68 tomatoes showing what appeared to be incipient blossom-end rot were selected. The affected areas were marked, and the tomatoes were allowed to ripen. Only 10 percent of the tomatoes showed a spread of the affected area, and this was slight. The color of the enlarged area was light buff, and the area did not resemble what is ordinarily considered blossom-end rot. The injury was almost entirely superficial.

FIGURE 2.—Tomatoes hauled 15 miles over an unpaved road: *A*, Fruits with shoulders in contact with rough shook of field crate; *B*, fruit with corrugated paper between shoulders and rough shook.



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